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PORTERAGE PARAMETERS AND TABLES

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PREFACE AND SUMMARY

This Memorandum was compiled to fill an apparent need for a convenient set of computational methods and tables dealing with supply transportation by porters. The importance of porterage has been a recurrent and sometimes disputed issue in American military planning, as small-scale conflicts have occurred in underdeveloped areas, particularly southern and southeastern Asia. The position taken here is that it would be a mistake either to dismiss porterage as trivial or to attribute virtually limitless capacities to it. Supplies can be moved in this way, but the method can be costly and inefficient, especially over any but short distances.

The crux of the study is the productivity of human porters, and hence the number of men required to move a given quantity of supplies over a given line of communication. The answers have a direct bearing on insurgent military capability, the value of civilian labor to a guerrilla force, the likelihood of detection of porters moving at night, and the probable results of attacks on trails.

For this study, porter requirements have been computed and tabulated for several combinations of porter load capacity, daily and total travel distance, and food consumption, under three methods of food supply: all food available en route, each porter carrying his own food for the complete journey, and food carried but with staging or consolidation of loads as food is consumed. The unit of output employed is the number of porters required to transport one ton of supplies per day over a line of communication.

Useful inputs for the study were drawn from a number of previous RAND Memoranda and from reports issued by the Operations Research

Office of the Johns Hopkins University (see "References," p. 49).

The Memorandum is intended as an aid to military planners who must answer questions related to combat capability and logistics when a military force, either friendly or enemy, is dependent on porter transportation. It is related to current RAND work on Viet Cong logistics.

CONTENTS

I. INTRODUCTION

Primitive, nonmechanized transportation is a characteristic of guerrilla warfare and insurgency, particularly in countries where transportation networks are not well developed. Porters, pack animals, and oxcarts can use trails unsuitable for motor vehicles, do not require gasoline and expensive maintenance, and can often disappear into the countryside and avoid being identified as guerrilla or insurgent transport during daylight hours. Manpower is readily available for porterage in some of the underdeveloped areas most vulnerable to insurgency, and there is no requirement for training* or special skills.

But while these primitive transport capabilities should not be ignored in studies of small-scale warfare in such countries as Vietnam and Thailand, neither should they be overrated. Porterage operations extending beyond very short distances can require large numbers of men and large amounts of food, and in many cases the food must also be transported. Porterage in such inhospitable areas as the jungles of the India-Burma border and the Himalayan mountains can be costly for just this reason. Supply movement over several hundred miles of trail, when food is not available en route, requires a mass movement of porters carrying food and supplies at the initial stages in order to support a thin flow of porters and supplies arriving at the destination.

Previous RAND studies have dealt with porter requirements and porter and trail capabilities appropriate to the specific situations under study: Viet Minh operations,[1] Communist capabilities for

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*North Vietnamese training for infiltration southward has been reported to include training in carrying heavy loads.

logistic support in Southeast Asia, military operations in the Himalayas. The Korean experience, as reported by ORO [2,3] and others, and Viet Minh doctrine have provided most of the background data on porter capabilities. In each case the two components of porter workload -- the weight of the load and the daily travel distance -- have been related to the geographic and military factors of the particular situations.

The American Mount Everest expedition in 1963 [4] used Nepali porters (Tamangs and Sherpas) from Kathmandu east to Namche Bazar, with some Sherpas continuing to higher altitudes. Expedition cargo was packed in 65-pound loads, and each porter carried one load plus a small quantity of personal possessions and some rice; daily distances ranged from 8 to 15 miles and the 180-mile trip to Namche Bazar took 16 days of up-and-down walking. The additional time for each porter to complete the round trip is not reported.

This study is a more general treatment of porterage, using several sets of assumptions on porter workload, food availability, and staging doctrine. It is written to show:

1) Some of the more commonly used values for porter workload.

2) The impact of the availability of food en route and of the use of staging where food must be transported; this is illustrated by comparison of porter requirements under different staging doctrines.

3) Porter and food requirements for transporting given tonnages of supplies over given distances, for various combinations of porter workload, en route food availability, and staging policy.

4) Methods of estimating the density of porters on trails, for use in studies of reconnaissance and interdiction of trails and porterage operations.

The tables in Secs. V, VI and VIII were prepared by JOSS II.*

*JOSS is the trademark and service mark of The RAND Corporation for its computer program and services using that program.

II. PORTER WORKLOAD AND FOOD REQUIREMENTS

There are two primary components of porter workload: the weight of the load a porter can carry, and the distance he can travel in a day.

For trail capacity and interdiction computations, it is useful to have additional information about porter travel time. Over an 18-mile daily stretch, for example, a porter traveling 2 miles per hour for 9 hours occupies trail space and is vulnerable to detection from the air for a longer period than is a porter who walks at 3 mph for 6 hours.

Porter food requirements enter into computations in several ways. If a porter must carry his own food, his useful payload is smaller; if he does not carry his own food and food is not available en route, additional porters will be needed for food transport. Food requirements are also a component of the cost of a porterage operation. Purchasing food costs either money or goods; hunting and gathering food, in the rare situations where this is possible, takes time that might otherwise be spent in carrying payload forward; requisitioning food from local inhabitants costs local good will, and may be quite expensive if the porterage operation lasts more than a few days.

Table 1 summarizes payload and daily travel distances from several sources. Porter productivity is related to environment and in these sources is within a range of .04 to .21 ton-miles per man per working day. The porter loads given in Ref. 3 go as high as 150 pounds, but these are for a quite different situation. South Koreans forced to assist the North Korean army, and for short periods. Some porters may carry much heavier loads in other circumstances as well; Ref. 4 tells of a porter who carried a 135-pound load on the

last stage to the expedition's base camp at 17,800 feet altitude, and similar exceptional performances have been reported in Vietnam. It is the average load that is important here, however, not the maximum that can be carried by the strongest porter on the team.

Food requirements given in several sources fall in the range of 2 to 3 pounds per man per day. One value used in previous RAND work is 2.68 pounds (1216 grams) per man per day, the figure chosen for the present study. The variations in ton-mile productivity factors appear to be the result of terrain, illumination, and load differences, not of the size of the food ration. A porter carrying a 30-pound box of ammunition over 8 miles of mountain trail at night probably expends about as much energy as a porter carrying a 55-pound sack of rice along 16 miles of flat trail in the daytime. Short rations could, of course, reduce porter strength and productivity below the values used here. The effect of food ration weight on requirements for porters is discussed and illustrated in Sec. VIII.

The term "load" is used in this paper to include both supplies being moved to the destination and food being consumed en route, whether the food is consumed by the porter carrying it, by porters on later stages of the journey, or by supervisory personnel. "Throughput" refers to delivery of supplies to the destination. For simplicity, everything delivered to the consuming military units at the destination is termed "supplies" and everything used by porters and porter supervisors is called "food."

Table 1

PORTER WORKLOAD

Situation and Terrain	Normal Full Load	Daily Travel Distance	Source
Viet Minh planning factors, flat terrain	25 kg (55 lb) rice; 15-20 kg (33-44 lb) ammunition	25 km (15.5 mi) if by day; 20 km (12.4 mi) if by night	Ref. 1
Viet Minh factors, mountainous terrain	13 kg (29 lb) rice; 10-15 kg (22-33 lb) ammunition	15 km (9.3 mi) if by day; 12 km (7.5 mi) if by night	Ref. 1
Assumptions from Viet Minh experience	50 lb (22 kg)	15 mi (24 km) if loaded; 20 mi (32 km) if returning	(a)
Himalayan mountains	60 lb (27 kg)	9 mi (14.5 km)	(a)
Sustained use of bearers by UN forces in Korea	40 lb (18 kg)	8 mi (13 km)	Ref. 2
Mountainous terrain in Nepal, peacetime	Somewhat over 65 lb (29 kg)	11-12 mi (18-19 km) average when loaded	Ref. 4
A sample Viet Cong porter company in mountainous terrain	30 to 33 kg (66 to 73 lb) mixed loads	12 km (7.5 mi) taking 4 hours	(a)
A sample Viet Cong supply route using local village labor	15-40 kg (33-88 lb)	"To the next village"	(a)

[a]Unclassified data used in classified RAND sources.

III. PORTERAGE OPERATIONAL PROCEDURES

Porters carrying loads over short distances may be able to make the round trip in a day, or may rest overnight at the destination and then return to the origin point. For the longer distances of interest here, however, intermediate rest points are necessary, and these may also be used as staging points where one group of porters transfer their loads to another group.

If food is available en route, porters can travel the entire distance of supply movement, resting at intermediate stations, or each porter can work only over the distance between two adjacent rest stations, with loads transferred from porter to porter in the manner of a bucket brigade. There may be significant advantages to one or the other of these methods of operation in a given situation, particularly if porters can be based at their home villages, but the total porter and food requirements are the same and the question of through travel versus staging can be ignored in computations.

If food for porters must be brought from the origin of the porterage operation, three methods are available. Each porter may travel over the entire distance, carrying his food for the complete journey and as much payload as is possible after allowing for food. Some porters may carry only payload and walk through to the destination, while others carry food to intermediate rest points. Or each porter may work over a single stage, transferring his load at a rest point to a porter assigned to the next stage.

Stages can be short enough for a porter to make one or more complete round trips in one day, or long enough that he must rest overnight

(or for the daylight period if porterage is limited to hours of darkness) before returning to his origin point. Shorter stages require more staging facilities; longer stages require that food be carried for the return journey, causing a slight increase in food transport requirements.

Staging operations are computationall equivalent to operations in which all porters start at the origin of the supply movement, some carry supplies to the destination, and others carry food to intermediate staging points. In both cases porters are fully loaded whenever moving toward the destination. The case in which each porter carries his own food for the journey, however, is less efficient; after the first two or three days the porter is carrying significantly less than his maximum load because he has eaten some of the initial burden. It is, of course, possible to consolidate loads and have some porters return to the origin, and also possible for porters to leave food along the way for their own use on the return journey; to the extent to which this is done, the porter requirements approach those for a staging operation.

The food transportation method associated with a porterage operation will take a different form if enough food is available at some point en route or at the destination to supply food requirements at staging or resting stations. If the entire operation can be supported from food available at the destination, and if the total haul is short enough, then porters will be able to carry enough food back from the destination to maintain stocks at intermediate stations and the total porter requirements will be the same as if food were available at these stations without porterage. Availability of any portion of porter food requirements either en route or at the destination will

reduce food porterage somewhat, and therefore reduce the overall requirements for porters for the mission.

Long-distance porterage requires some sort of en route supervision and management. A minimum level of supervision might be one or two people in charge of each rest station or staging point; some porterage operations will require guards or patrols to protect against attacks on porters, escorts to guide porters or prevent defections, personnel to open and distribute rations at staging points, and the like. Supervisory tasks will be affected by the method of operations; if porters shuttle over short stages they are less likely to need guides but more likely to need loading supervisors at staging points. Vulnerability of the operation to enemy attack or porter defections is another factor. In any case, some supervision is necessary, if only to decide which loads go forward and which are held at way-stations whenever porters are injured or get sick.

For the following computations, four cases have been considered:

1) Food is available en route; all porter capability is used to move supplies forward. No supervision requirements are included, and any supervisors, guards, etc., required are assumed to be self-sustaining.

2) No food is available en route. Each porter carries food for the entire round-trip journey plus supplies to the limit of his capacity. No allowance is made for food for supervisors or guards.

3) No food is available en route. Porters work over short stages, each carrying a load forward to the end of the stage and returning to

the beginning of the stage on the same day. Each porter carries supplies, food for later stages, or a combination of these; he eats at the beginning of the stage and carries none of his own food on the journey. No allowance is made for supervisors or guards.

4) No food is available en route. Staging operation is as outlined above. En route food requirements on each stage have been increased 10 percent for supervisors and guards, implying that each stage has one nonporter (living and eating at the beginning of the stage) for each 10 porters carrying loads on the stage.

Other operational procedures can be treated as follows:

Porters travel through over the entire distance, but loads are consolidated and some porters sent back to the origin as food is consumed: this is equivalent in computation to staging, and to cases 3 and 4 above when no food is available en route.

Some types of food are available en route, some must be transported: this can be treated by using a food requirement, in computations, which is the weight of the portion of the food that is not available locally. It may also be treated by computing part of the porter requirement with case 1 values, and the remainder by using case 3 or 4.

Food available at some en route points, but not all: this can be treated as a chain of porterage operations, some with food available en route and some with a requirement to carry food. It should be noted that food can be transported free from an en route or destination point back along the trail toward the origin, up to the level at which all returning porters leave the food-supply station fully loaded with

food.* Requirements for food for supervisors and guards must be considered when determining how much of a trail can be supplied with food back-hauled free from a point where food is available. In general, if food is available in adequate quantity at one or more en route points or at the destination, each intermediate station should be supplied with food from a forward food-supply point if it can be back-hauled free.

Porters travel with escorts or guards, and there is no staging or consolidation of loads: if escorts and guards carry their own food, no added porters are needed. If porters must carry food for escorts or guards, food requirements are increased and the supply load per porter is correspondingly reduced.

Staging as in cases 3 or 4, but staging points are twice as far apart and porters rest and eat at the end of the stage before returning: this requires fewer staging points and probably fewer supervisory personnel, but there is a small increase in food porterage because porters eat at the far end of their round-trip journeys. The difference from cases 3 and 4 is not large enough to merit separate treatment.

Staging with supervision but with the total number of supervisors and guards either more or less than 10 percent of the number of porters: equations for case 4 apply, but the factor (1.1) must be replaced by the ratio (porters + guards + supervisors)/(porters) applicable to the situation under study.

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*This is strictly true only if daily travel distance is the same for loaded porters as for porters not carrying loads.

IV. METHOD OF COMPUTATION

Computations of porter requirements and food requirements under the four operating procedures of Sec. III are based on the following inputs:

p = weight of the load (supplies + food) a porter can carry.

d = distance a porter can travel in one day; if porters travel faster when light than when loaded, d is defined as the total distance traveled in one day when the man carries a load for the first half of the distance and no load for the second half.

f = weight of the food consumed by one porter in one day.

D = total distance over which supplies are transported.

T = total weight of supplies required per day at the destination. This does not include en route food.

Computations can provide two outputs:

N = number of porters needed on any given day.

F = total weight of food consumed by all porters in one day.

An important intermediate value for staging operations is

s = number of stages into which the distance D is divided.

Some of the relationships are obvious for all cases considered:

$F = Nf$

$s = D \div (d/2) = 2D/d$, given the stage-length assumptions of cases 3 and 4 of Sec. III.

The tables in Secs. V and VI have been computed for T = one ton. Food requirements (F) have not been tabulated, but can be computed easily; total daily food requirements are 2.68 pounds per man, or 1.34 tons per 1000 men, and one ton of food per day supports 746 men.

Case 1 equations (food available en route) are quite simple. An individual porter takes 2D/d days for a round trip, and T/p porters must arrive at the destination each day. The number of porters is therefore

$$N = 2DT/dp$$

If staging is used, each stage requires T/p porters per day; each porter on a stage makes one round trip per day, so that the porter requirement is T/p porters per stage; for s stages, the number of porters is

$$N = sT/p \quad ,$$

which is equivalent to the earlier equation since $s = 2D/d$.

Food requirements in this case are

$$F = 2DTf/dp = sTf/p$$

and this must be available in quantities of Tf/p per day at each staging point when short stages (one day's round trip distance) are used.

Case 2 (porters carry own food for entire journey, no consolidation of loads) requires that each porter carry f weight of food for $[(2D/d) - 1]$ days, a total food weight of $f[(2D/d) - 1]$. The payload per porter is correspondingly reduced to $[p - f((2D/d) - 1)]$. The number of porters who must arrive at the destination each day is $T/[p - f((2D/d) - 1)]$ and since the round-trip time, as in case 1, is 2D/d days, the number of porters required is

$$N = \frac{2DT}{dp - df[(2D/d) - 1]} = \frac{sT}{p - f(s - 1)} \quad .$$

The total food requirement is

$$F = \frac{2fDT}{dp - df[(2D/d) - 1]} = \frac{fsT}{p - f(s - 1)} \quad .$$

Case 2 has a maximum possible length of the supply line, which is the distance at which the initial load must consist entirely of food for the porter's round trip. This distance is that at which the denominator of N and F in the above equations goes to zero: $(d/2)(1 + p/f)$.

Case 3 equations (staging, all food transported, no supervisors) are derived as follows:

Delivery of a total payload weight of T per day at the destination requires the employment of T/p porters on the final stage. These porters consume fT/p food per day.

Porters assigned to the next-to-last stage must transport a total load of $[T/p][1 + (f/p)]$ porters and a daily consumption of $f[T/p][1 + (f/p)]$ food on this stage.

For the k^{th} stage the number of porters required is $[T/p][1 + (f/p)]^{(k-1)}$ and the food requirement is $f[T/p][1 + f/p)]^{(k-1)}$ per day.

Summing over an s-stage porterage operation, total requirements become:

$$\text{Men:} \quad N = [T/p] \sum_{i=1}^{s} [1 + (f/p)]^{(i-1)}$$

$$\text{Food: } F = fN = [fT/p] \sum_{i=1}^{s} [1 + (f/p)]^{(i-1)}$$

These equations can be simplified, however, by introducing $[f/p]$ inside the summation, with results as follows:

$$\text{Food: } F = T \sum_{i=1}^{s} [f/p][1 + (f/p)]^{(i-1)}$$

$$F = T \sum_{i=1}^{s} [1 + (f/p) - 1][1 + (f/p)]^{(i-1)}$$

$$F = T \sum_{i=1}^{s} [1 + (f/p)][1 + (f/p)]^{(i-1)}$$

$$- [1 + (f/p)]^{(i-1)}$$

$$F = T \sum_{i=1}^{s} [1 + (f/p)]^{i} - [1 + (f/p)]^{(i-1)} \quad ,$$

which simplifies to

$$F = T\{[1 + (f/p)]^{s} - 1\} \quad .$$

Similarly, the number of porters simplifies to

$$N = [T/f]\{[1 + (f/p)]^{s} - 1\} \quad .$$

Case 4 (staging as in case 3, with a 10-percent allowance for supervision) differs from case 3 only in that food requirements per stage are increased by 10 percent, with a corresponding increase in the number of porters required, and supervisory manpower then must be added to the porter requirement to get the total number of men required to conduct the porterage operation. Equations are as follows:

Number of porters:

$$N = \frac{T}{(1.1)f}\left[\left(1 + \frac{(1.1)f}{p}\right)^{s} - 1\right] .$$

Total number of personnel: $1.1N$.

Food per day: $1.1fN$.

V. TABLES, PART I: PORTER REQUIREMENTS FOR VARYING LOAD CAPACITY

Tables 2 through 14 show porter requirements as a function of the load a porter can carry, the number of days of porter travel time from one end of the supply line to the other, and the porterage operational procedure used. These are tabulated for loads from 30 to 90 pounds, in 5-pound increments.

"Supply Movement Distance" columns are in terms of travel time; porter requirements for a supply movement over a particular distance can be computed from these tables by conversion of the mileage distance into travel time or number of stages, using the formula $s = 2D/d$, where D is the length of the supply line (in miles or km), d is the one-way distance a porter can travel in one day (also in miles or km), and s is the number of stages in the journey. A "stage", as discussed in Sec. III, is the distance over which a porter can carry a load in one working day or night period and return to his point of origin during the same period.

Cases 1 through 4 are the cases discussed in Sec. III, and these tables have been computed by the formulas of Sec. IV. Where no value appears in the case 2 column, the distance is too long for a porter to travel round-trip when he must carry all of his food for the journey from the point of origin. Porter requirements for cases 3 and 4 have been omitted whenever porter requirements were so large as to require more than one million porters per ton of throughput.

Under the assumptions used here, in which the supervision of case 4 is linearly proportional to the number of porters, porter requirements are in linear proportion to tonnage throughput per day,

and therefore can be multiplied by the tonnage requirement at the destination to get porter requirements for any desired throughput.

The food requirement in all cases is 2.68 pounds (1214 grams) per man per day.

Porters are assumed to work a seven-day week; any allowance for days off or for illness will increase the numbers shown in these tables.

Some explanatory remarks about Tables 2 through 14 may be useful.

The large number of porters needed for a 14-stage trip in Case 2, Table 3, is not a misprint; the food needed at 2.68 pounds a day for 13 days away from home base is 34.84 pounds, leaving about 2½ ounces available for payload. The 12-stage entry in Table 2 and the 34-stage entry in Table 14 also show the sharp increase in porter requirements as the physical limits of porterage by the Case 2 operational procedure are approached.

The differences between the Case 3 column and the Case 4 porter column show the additional porters needed to carry food for supervisors, while the larger figures of the "Total" column of Case 4 include the manpower needed for supervision as well as porterage.

Porter requirements for supply movement distances not shown here can be computed by interpolating between values shown in the table; results will be accurate for Case 1, and somewhat higher than the true values for other cases but close enough to be usable.

These comments also apply to Tables 15 through 22.

An example using these tables is given in Sec. VII, beginning on page 43.

Table 2

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 30 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	133	146	139	140	154
2	4	267	364	305	309	339
3	6	400	723	501	512	563
4	8	533	1423	733	758	833
5	10	667	3401	1010	1054	1159
6	12	800	46154	1337	1411	1552
7	14	933		1726	1842	2026
8	16	1067		2188	2361	2597
9	18	1200		2735	2988	3287
10	20	1333		3385	3744	4118
11	22	1467		4156	4656	5121
12	24	1600		5071	5756	6331
13	26	1733		6157	7082	7791
14	28	1867		7446	8683	9551
15	30	2000		8975	10613	11674
16	32	2133		10789	12941	14235
17	34	2267		12942	15749	17324
18	36	2400		15497	19136	21050
19	38	2533		18529	23222	25544
20	40	2667		22127	28150	30965
22	44	2933		31462	41263	45390
24	48	3200		44607	60342	66376
26	52	3467		63118	88100	96910
28	56	3733		89183	128485	141333
30	60	4000		125886	187241	205965
32	64	4267		177558	272724	299996
34	68	4533		250344	397093	436802
36	72	4800		352821	578036	635840
38	76	5067		497123	841290	925419
40	80	5333		700319		
42	84	5600		986446		
44	88	5867				
46	92	6133				
48	96	6400				
50	100	6667				

Table 3

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 35 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	114	124	119	119	131
2	4	229	297	256	259	285
3	6	343	556	416	424	466
4	8	457	985	600	617	679
5	10	571	1838	814	845	929
6	12	686	4348	1093	1112	1223
7	14	800	175000	1350	1426	1569
8	16	914		1684	1796	1975
9	18	1029		2070	2230	2453
10	20	1143		2518	2741	3015
11	22	1257		3037	3341	3675
12	24	1371		3638	4047	4451
13	26	1486		4335	4876	5364
14	28	1600		5143	5851	6436
15	30	1714		6080	6997	7697
16	32	1829		7165	8345	9179
17	34	1943		8423	9929	10922
18	36	2057		9881	11791	12970
19	38	2171		11571	13980	15378
20	40	2286		13530	16554	18209
22	44	2514		18431	23135	25448
24	48	2743		25014	32230	35453
26	52	2971		33858	44798	49278
28	56	3200		45737	62166	68383
30	60	3429		61694	86168	94785
32	64	3657		83130	119337	131271
34	68	3886		111924	165173	181691
36	72	4114		150603	228516	251367
38	76	4343		202560	316050	347655
40	80	4571		272355	437015	480717
42	84	4800		366109	604180	664598
44	88	5029		492048	835188	918707
46	92	5257		661222		
48	96	5486		888473		
50	100	5714				

Table 4

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 40 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	100	107	103	104	114
2	4	200	250	221	223	246
3	6	300	451	355	361	397
4	8	400	754	507	520	572
5	10	500	1259	681	703	773
6	12	600	2281	879	914	1006
7	14	700	5426	1104	1158	1273
8	16	800		1360	1438	1582
9	18	900		1652	1762	1938
10	20	1000		1984	2135	2348
11	22	1100		2362	2564	2821
12	24	1200		2792	3060	3366
13	26	1300		3282	3631	3995
14	28	1400		3840	4290	4719
15	30	1500		4476	5049	5554
16	32	1600		5199	5925	6517
17	34	1700		6022	6934	7627
18	36	1800		6959	8097	8907
19	38	1900		8027	9439	10383
20	40	2000		9242	10985	12083
22	44	2200		12200	14822	16305
24	48	2400		16034	19923	21915
26	52	2600		21003	26730	29371
28	56	2800		27444	35709	39280
30	60	3000		35793	47681	52449
32	64	3200		46614	63592	69951
34	68	3400		60641	84738	93212
36	72	3600		78821	112842	124127
38	76	3800		102385	150193	165212
40	80	4000		132928	199833	219816
42	84	4200		172517	265805	292386
44	88	4400		223830	353484	388832
46	92	4600		290340	470011	517012
48	96	4800		376547	624877	687365
50	100	5000		488266	830698	913768

Table 5

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 45 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	89	95	92	92	101
2	4	178	216	194	196	216
3	6	267	380	310	314	346
4	8	356	610	439	449	494
5	10	444	958	585	601	661
6	12	533	1546	748	774	852
7	14	622	2756	931	971	1068
8	16	711	6667	1137	1194	1314
9	18	800		1368	1447	1592
10	20	889		1627	1735	1909
11	22	978		1918	2062	2268
12	24	1067		2245	2433	2676
13	26	1156		2612	2853	3139
14	28	1244		3024	3331	3665
15	30	1333		3486	3874	4261
16	32	1422		4005	4490	4939
17	34	1511		4588	5189	5708
18	36	1600		5243	5983	6582
19	38	1689		5977	6885	7573
20	40	1778		6802	7908	8699
22	44	1956		8767	10389	11428
24	48	2133		11244	13587	14946
26	52	2311		14366	17709	19480
28	56	2489		18301	23022	25324
30	60	2667		23260	29869	32856
32	64	2844		29510	38696	42566
34	68	3022		37387	50073	55080
36	72	3200		47316	64737	71210
38	76	3378		59830	83637	92001
40	80	3556		75601	107999	118799
42	84	3733		95479	139401	153341
44	88	3911		120532	179875	197862
46	92	4089		152108	232043	255248
48	96	4267		191906	299285	329214
50	100	4444		242065	385956	424552

Table 6

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 50 POUNDS

Supply Movement Distance		Case 1	Case 2	Case 3	Case 4	
		No Food Carried	Porters Carry Own Food	Staging Operation	Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	80	85	82	82	91
2	4	160	181	173	175	192
3	6	240	328	275	278	306
4	8	320	512	387	394	434
5	10	400	773	512	525	577
6	12	480	1170	650	671	738
7	14	560	1847	804	834	918
8	16	640	3265	974	1018	1120
9	18	720	8108	1164	1224	1347
10	20	800		1374	1455	1601
11	22	880		1607	1714	1885
12	24	960		1867	2005	2205
13	26	1040		2154	2330	2563
14	28	1120		2473	2695	2965
15	30	1200		2828	3105	3416
16	32	1280		3221	3564	3921
17	34	1360		3658	4079	4487
18	36	1440		4143	4657	5123
19	38	1520		4681	5305	5835
20	40	1600		5278	6031	6634
22	44	1760		6678	7759	8535
24	48	1920		8402	9932	10925
26	52	2080		10527	12664	13931
28	56	2240		13145	16100	17710
30	60	2400		16371	20421	22463
32	64	2560		20347	25855	28441
34	68	2720		25246	32688	35957
36	72	2880		31283	41281	45409
38	76	3040		38722	52087	57296
40	80	3200		47890	65676	72243
42	84	3360		59186	82764	91040
44	88	3520		73106	104252	114678
46	92	3680		90259	131275	144403
48	96	3840		111396	165257	181783
50	100	4000		137442	207991	228790

Table 7

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 55 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	73	76	74	75	82
2	4	145	170	156	158	173
3	6	218	286	247	250	275
4	8	291	442	346	352	387
5	10	364	648	455	465	512
6	12	436	940	575	591	650
7	14	509	1389	706	731	804
8	16	582	2162	851	886	974
9	18	655	3814	1011	1058	1164
10	20	727	9804	1186	1249	1374
11	22	800		1379	1461	1607
12	24	873		1591	1697	1867
13	26	945		1825	1958	2154
14	28	1018		2082	2249	2473
15	30	1091		2364	2571	2828
16	32	1164		2674	2928	3221
17	34	1236		3016	3325	3658
18	36	1309		3391	3766	4143
19	38	1382		3804	4255	4681
20	40	1455		4259	4798	5278
22	44	1600		5308	6071	6678
24	48	1745		6577	7638	8402
26	52	1891		8112	9570	10527
28	56	2036		9969	11950	13145
30	60	2182		12215	14883	16371
32	64	2327		14932	18497	20347
34	68	2473		18219	22951	25246
36	72	2618		22194	28439	31283
38	76	2764		27003	35202	38722
40	80	2909		32820	43536	47890
42	84	3055		39856	53805	59186
44	88	3200		48367	66460	73106
46	92	3345		58663	82053	90259
48	96	3491		71116	101269	111396
50	100	3636		86180	124947	137442

Table 8

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 60 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	67	70	68	68	75
2	4	133	154	140	143	158
3	6	200	258	224	226	249
4	8	267	388	312	317	349
5	10	333	557	409	418	459
6	12	400	786	514	528	581
7	14	467	1113	630	649	714
8	16	533	1616	755	783	861
9	18	600	2493	892	930	1023
10	20	667	4405	1042	1092	1201
11	22	733	11828	1205	1270	1397
12	24	800		1384	1467	1613
13	26	867		1578	1683	1851
14	28	933		1790	1920	2112
15	30	1000		2022	2182	2400
16	32	1067		2275	2470	2717
17	34	1133		2551	2787	3066
18	36	1200		2852	3136	3449
19	38	1267		3181	3520	3872
20	40	1333		3539	3943	4337
22	44	1467		4358	4920	5412
24	48	1600		5333	6104	6714
26	52	1733		6494	7538	8292
28	56	1867		7877	9276	10204
30	60	2000		9523	11381	12520
32	64	2133		11485	13932	15325
34	68	2267		13821	17022	18724
36	72	2400		16603	20766	22842
38	76	2533		19917	25301	27831
40	80	2667		23864	30796	33876
42	84	2800		28564	37453	41198
44	88	2933		34163	45517	50069
46	92	3067		40830	55288	60817
48	96	3200		48771	67124	73837
50	100	3333		58229	81465	89611

Table 9

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 65 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	62	64	63	63	69
2	4	123	140	131	132	145
3	6	185	233	205	207	228
4	8	246	346	285	289	318
5	10	308	489	372	379	417
6	12	369	676	466	477	524
7	14	431	928	568	583	642
8	16	492	1290	678	701	771
9	18	554	1852	798	829	912
10	20	615	2841	928	969	1066
11	22	677	5046	1069	1122	1234
12	24	738	14286	1222	1289	1418
13	26	800		1387	1471	1618
14	28	862		1567	1671	1838
15	30	923		1762	1888	2077
16	32	985		1973	2127	2339
17	34	1046		2201	2387	2625
18	36	1108		2450	2671	2938
19	38	1169		2719	2982	3280
20	40	1231		3010	3321	3653
22	44	1354		3669	4098	4508
24	48	1477		4444	5025	5528
26	52	1600		5354	6132	6746
28	56	1723		6424	7455	8200
30	60	1846		7682	9033	9937
32	64	1969		9160	10919	12011
34	68	2092		10897	13170	14487
36	72	2215		12940	15859	17445
38	76	2338		15340	19069	20976
40	80	2462		18162	22903	25193
42	84	2585		21479	27431	30229
44	88	2708		25377	32948	36242
46	92	2831		29959	39476	43423
48	96	2954		35345	47271	51998
50	100	3077		41676	56579	62237

Table 10

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 70 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	57	59	58	58	64
2	4	114	129	121	122	134
3	6	171	212	189	191	210
4	8	229	312	262	265	292
5	10	286	436	340	346	381
6	12	343	592	425	435	478
7	14	400	796	517	530	583
8	16	457	1074	615	634	698
9	18	514	1473	721	747	822
10	20	571	2096	836	870	957
11	22	629	3207	959	1003	1103
12	24	686	5742	1092	1147	1262
13	26	743	17333	1236	1304	1435
14	28	800		1391	1475	1623
15	30	857		1557	1660	1826
16	32	914		1737	1861	2047
17	34	971		1931	2080	2288
18	36	1029		2140	2317	2549
19	38	1086		2365	2575	2832
20	40	1143		2608	2854	3140
22	44	1257		3152	3488	3837
24	48	1371		3784	4236	4659
26	52	1486		4518	5117	5629
28	56	1600		5372	6157	6773
30	60	1714		6364	7383	8122
32	64	1829		7517	8829	9712
34	68	1943		8858	10535	11589
36	72	2057		10415	12547	13802
38	76	2171		12225	14920	16412
40	80	2286		14328	17718	19490
42	84	2400		16773	21018	23120
44	88	2514		19614	24911	27402
46	92	2629		22916	29501	32451
48	96	2743		26753	34916	38407
50	100	2857		31212	41301	45431

Table 11

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 75 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	53	55	54	54	60
2	4	107	119	113	113	124
3	6	160	195	175	177	194
4	8	213	294	242	245	270
5	10	267	393	314	319	351
6	12	320	527	391	399	439
7	14	373	697	474	485	534
8	16	427	920	562	579	637
9	18	480	1223	658	680	747
10	20	533	1661	760	788	867
11	22	587	2350	869	906	997
12	24	640	3593	987	1033	1136
13	26	693	6500	1113	1170	1287
14	28	747	21212	1248	1318	1450
15	30	800		1393	1478	1626
16	32	853		1549	1651	1816
17	34	907		1716	1838	2022
18	36	960		1895	2040	2244
19	38	1013		2087	2258	2483
20	40	1067		2293	2493	2742
22	44	1173		2752	3022	3324
24	48	1280		3279	3639	4003
26	52	1387		3886	4359	4794
28	56	1493		4584	5199	5718
30	60	1600		5388	6178	6796
32	64	1707		6313	7322	8054
34	68	1813		7377	8656	9521
36	72	1920		8602	10212	11233
38	76	2027		10012	12028	13231
40	80	2133		11634	14147	15561
42	84	2240		13501	16619	18281
44	88	2347		15649	19503	21453
46	92	2453		18121	22868	25155
48	96	2560		20966	26794	29479
50	100	2667		24239	31375	34512

Table 12

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 80 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	50	52	51	51	56
2	4	100	111	105	106	116
3	6	150	180	163	165	181
4	8	200	261	225	228	251
5	10	250	358	291	296	325
6	12	300	475	362	369	406
7	14	350	620	437	448	492
8	16	400	804	518	532	585
9	18	450	1045	604	623	685
10	20	500	1376	696	721	793
11	22	550	1855	794	826	908
12	24	600	2614	899	938	1032
13	26	650	4000	1012	1060	1166
14	28	700	7330	1131	1190	1309
15	30	750	26316	1259	1331	1464
16	32	800		1396	1481	1630
17	34	850		1542	1643	1808
18	36	900		1698	1818	2000
19	38	950		1864	2005	2206
20	40	1000		2042	2207	2427
22	44	1100		2435	2656	2921
24	48	1200		2883	3175	3493
26	52	1300		3394	3775	4153
28	56	1400		3977	4469	4916
30	60	1500		4643	5271	5798
32	64	1600		5402	6197	6817
34	68	1700		6268	7268	7995
36	72	1800		7257	8506	9357
38	76	1900		8384	9936	10930
40	80	2000		9671	11590	12749
42	84	2100		11138	13500	14850
44	88	2200		12812	15709	17280
46	92	2300		14723	18261	20087
48	96	2400		16902	21211	23332
50	100	2500		19388	24620	27082

Table 13

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 85 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	47	49	48	48	53
2	4	94	104	99	99	109
3	6	141	168	153	154	169
4	8	188	242	210	213	234
5	10	235	329	272	276	303
6	12	282	422	337	343	377
7	14	329	558	406	415	457
8	16	376	714	480	492	541
9	18	424	913	559	575	632
10	20	471	1174	642	663	730
11	22	518	1532	731	758	834
12	24	565	2055	826	859	945
13	26	612	2889	926	968	1065
14	28	659	4430	1034	1084	1192
15	30	706	8242	1148	1208	1329
16	32	753	33333	1269	1341	1476
17	34	800		1398	1484	1632
18	36	847		1535	1637	1800
19	38	894		1681	1800	1980
20	40	941		1837	1975	2172
22	44	1035		2178	2363	2599
24	48	1129		2565	2807	3088
26	52	1224		3003	3316	3648
28	56	1318		3499	3900	4290
30	60	1412		4060	4569	5026
32	64	1506		4695	5335	5869
34	68	1600		5415	6214	6836
36	72	1694		6229	7221	7943
38	76	1788		7151	8376	9213
40	80	1882		8196	9698	10668
42	84	1976		9378	11215	12336
44	88	2071		10716	12952	14248
46	92	2165		12232	14944	16438
48	96	2259		13947	17227	18949
50	100	2353		15890	19843	21827

Table 14

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR PORTER LOAD OF 90 POUNDS

Supply Movement Distance		Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Days Travel Time	Number of Stages	Porters	Porters	Porters	Porters	Total
1	2	44	46	45	45	50
2	4	89	98	93	93	103
3	6	133	157	144	145	159
4	8	178	225	197	200	220
5	10	222	304	254	258	284
6	12	267	397	315	320	352
7	14	311	508	379	387	426
8	16	356	643	447	458	504
9	18	400	810	519	533	587
10	20	444	1024	596	614	676
11	22	489	1305	677	700	770
12	24	533	1693	763	792	871
13	26	578	2261	854	890	979
14	28	622	3175	951	994	1094
15	30	667	4886	1053	1106	1216
16	32	711	9249	1162	1225	1347
17	34	756	43590	1278	1351	1486
18	36	800		1400	1486	1635
19	38	844		1530	1630	1794
20	40	889		1667	1784	1963
22	44	978		1968	2123	2335
24	48	1067		2306	2509	2759
26	52	1156		2686	2947	3242
28	56	1244		3113	3446	3791
30	60	1333		3594	4014	4415
32	64	1422		4134	4659	5125
34	68	1511		4742	5394	5933
36	72	1600		5426	6229	6852
38	76	1689		6194	7180	7898
40	80	1778		7059	8261	9087
42	84	1867		8031	9491	10440
44	88	1956		9124	10890	11979
46	92	2044		10353	12482	13730
48	96	2133		11735	14293	15722
50	100	2222		13290	16353	17969

VI. TABLES, PART II: PORTER REQUIREMENTS FOR SPECIFIC COMBINATIONS OF LOAD CAPACITY AND DAILY TRAVEL

The tables in this section are similar to those of Sec. V, but are for eight specific combinations of payload and daily travel distance, so that the distance of supply movement is shown in terms of miles and kilometers as well as number of stages. These correspond to the porter workload factors of Table 1 as follows:

Table 15, 30 pounds and 9.3 miles (15 km), corresponds to Viet Minh planning factors for carrying rice or ammunition in mountainous terrain by day.

Table 16, 30 pounds and 7.5 miles (12 km), corresponds to Viet Minh factors for rice or ammunition in mountainous areas at night.

Table 17, 40 pounds and 15.5 miles (25 km), corresponds to Viet Minh factors for ammunition in flat terrain by day.

Table 18, 40 pounds and 12.4 miles (20 km), corresponds to Viet Minh factors for ammunition in flat terrain at night.

Table 19, 50 pounds and 17.14 miles (29.3 km), is from RAND sources and is based on Viet Minh experience.

Table 20, 55 pounds and 15.5 miles, corresponds to Viet Minh factors for transporting rice in flat terrain by day.

Table 21, 55 pounds and 12.4 miles, corresponds to Viet Minh factors for rice in flat terrain at night.

Table 22, 60 pounds and 9 miles, corresponds to the planning factors used for porterage in the Himalayan mountains in a RAND analysis.

The explanatory remarks on page 14 for Tables 2 through 14 also apply to Tables 15 through 22.

Table 15

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR DAILY TRAVEL OF 9.30 MILES AND MAXIMUM LOAD
OF 30 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	2.15	143	160	151	152	167
20	32.2	4.30	287	407	332	337	371
30	48.3	6.45	430	838	550	564	620
40	64.4	8.60	573	1787	812	841	925
50	80.5	10.75	717	5567	1126	1180	1298
60	96.6	12.90	860		1505	1595	1755
70	112.7	15.05	1004		1960	2103	2314
80	128.8	17.20	1147		2506	2724	2997
90	144.9	19.35	1290		3163	3484	3833
100	161.0	21.51	1434		3953	4414	4856
110	177.1	23.66	1577		4903	5551	6107
120	193.2	25.81	1720		6044	6943	7637
130	209.3	27.96	1864		7416	8645	9509
140	225.4	30.11	2007		9065	10727	11800
150	241.5	32.26	2151		11047	13274	14602
160	257.6	34.41	2294		13429	16390	18029
170	273.7	36.56	2437		16293	20202	22222
180	289.8	38.71	2581		19736	24866	27352
190	305.9	40 86	2724		23874	30570	33627
200	322.0	43.01	2867		28848	37549	41304
220	354.2	47.31	3154		42014	56530	62183
240	386.4	51.61	3441		61037	84937	93430
260	418.6	55.91	3728		88523	127448	140193
280	450.8	60.22	4014		128237	191067	210174
300	483.0	64.52	4301		185619	286276	314903
320	515.2	68.82	4588		268529	428759	471635
340	547.4	73.12	4875		388324	641990	706189
360	579.6	77.42	5161		561413	961099	1057209
380	611.8	81.72	5448		811506		
400	644.0	86.02	5735				
420	676.2	90.32	6022				
440	708.4	94.62	6308				
460	740.6	98.92	6595				
480	772.8	103.23	6882				
500	805.0	107.53	7168				

Table 16

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR DAILY TRAVEL OF 7.50 MILES AND MAXIMUM LOAD
OF 30 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	2.67	178	209	191	193	212
20	32.2	5.33	356	580	432	440	484
30	48.3	8.00	533	1423	733	758	833
40	64.4	10.67	711	5212	1113	1165	1282
50	80.5	13.33	889		1589	1689	1858
60	96.6	16.00	1067		2188	2361	2597
70	112.7	18.67	1244		2940	3224	3547
80	128.8	21.33	1422		3885	4333	4766
90	144.9	24.00	1600		5071	5756	6331
100	161.0	26.67	1778		6563	7583	8341
110	177.1	29.33	1956		8436	9929	10922
120	193.2	32.00	2133		10789	12941	14235
130	209.3	34.67	2311		13746	16808	18489
140	225.4	37.33	2489		17460	21774	23951
150	241.5	40.00	2667		22127	28150	30965
160	257.6	42.67	2844		27989	36336	39969
170	273.7	45.33	3022		35355	46847	51531
180	289.8	48.00	3200		44607	60342	66376
190	305.9	50.67	3378		56232	77670	85437
200	322.0	53.33	3556		70836	99919	109911
220	354.2	58.67	3911		112232	165163	181680
240	386.4	64.00	4267		177568	272724	299996
260	418.6	69.33	4622		280688	450045	495050
280	450.8	74.67	4978		443443	742372	816610
300	483.0	80.00	5333		700319		
320	515.2	85.33	5689				
340	547.4	90.67	6044				
360	579.6	96.00	6400				
380	611.8	101.33	6756				
400	644.0	106.67	7111				
420	676.2	112.00	7467				
440	708.4	117.33	7822				
460	740.6	122.67	8178				
480	772.8	128.00	8533				
500	805.0	133.33	8889				

Table 17

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR DAILY TRAVEL OF 15.50 MILES AND MAXIMUM LOAD
OF 40 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	1.29	65	66	65	65	72
20	32.2	2.58	129	144	136	137	150
30	48.3	3.87	194	240	213	215	236
40	64.4	5.16	258	358	297	301	331
50	80.5	6.45	323	508	388	395	434
60	96.6	7.74	387	706	487	498	548
70	112.7	9.03	452	978	594	611	672
80	128.8	10.32	516	1375	711	735	809
90	144.9	11.61	581	2010	839	871	958
100	161.0	12.90	645	3186	977	1020	1122
110	177.1	14.19	710	6116	1127	1183	1301
120	193.2	15.48	774	26172	1291	136_	1498
130	209.3	16.77	839		1469	1558	1714
140	225.4	18.06	903		1662	1773	1950
150	241.5	19.35	968		1872	2008	2209
160	257.6	20.65	1032		2101	2267	2493
170	273.7	21.94	1097		2349	2550	2805
180	289.8	23.23	1161		2619	2860	3146
190	305.9	24.52	1226		2913	3200	3520
200	322.0	25.81	1290		3232	3572	3930
220	354.2	28.39	1419		3957	4429	4872
240	386.4	30.97	1548		4814	5457	6003
260	418.6	33.55	1677		5827	6693	7363
280	450.8	36.13	1806		7024	8178	8996
300	483.0	38.71	1935		8440	9962	10959
320	515.2	41.29	2065		10113	12106	13316
340	547.4	43.87	2194		12092	14681	16149
360	579.6	46.45	2323		14430	17775	19552
380	611.8	49.03	2452		17195	21491	23641
400	644.0	51.61	2581		20464	25957	28553
420	676.2	54.19	2710		24328	31322	34454
440	708.4	56.77	2839		28896	37768	41545
460	740.6	59.35	2968		34296	45512	50064
480	772.8	61.94	3097		40680	54816	60298
500	805.0	64.52	3226		48226	65995	72594

Table 18

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR DAILY TRAVEL OF 12.40 MILES AND MAXIMUM LOAD
OF 40 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera- tion	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	1.61	81	84	82	82	91
20	32.2	3.23	161	190	174	175	192
30	48.3	4.84	242	326	275	279	306
40	64.4	6.45	323	508	388	395	434
50	80.5	8.06	403	766	513	525	578
60	96.6	9.68	484	1156	652	672	739
70	112.7	11.29	565	1818	806	836	919
80	128.8	12.90	645	3186	977	1020	1122
90	144.9	14.52	726	7687	1167	1226	1349
100	161.0	16.13	806		1378	1458	1603
110	177.1	17.74	887		1612	1717	1889
120	193.2	19.35	968		1872	2008	2209
130	209.3	20.97	1048		2161	2335	2568
140	225.4	22.58	1129		2481	2701	2971
150	241.5	24.19	1210		2837	3112	3423
160	257.6	25.81	1290		3232	3572	3930
170	273.7	27.42	1371		3671	4086	4498
180	289.8	29.03	1452		4158	4669	5135
190	305.9	30.65	1532		4699	5318	5850
200	322.0	32.26	1613		5299	6047	6652
220	354.2	35.48	1774		6706	7781	8559
240	386.4	38.71	1935		8440	9962	10959
260	418.6	41.94	2097		10577	12706	13976
280	450.8	45.16	2258		13212	16157	17772
300	483.0	48.39	2419		16460	20497	22547
320	515.2	51.61	2581		20464	25957	28553
340	547.4	54.84	2742		25399	32825	36107
360	579.6	58.06	2903		31483	41463	45609
380	611.8	61.29	3065		38982	52328	57561
400	644.0	64.52	3226		48226	65995	72594
420	676.2	67.74	3387		59622	83185	91504
440	708.4	70.97	3548		73669	104808	115289
460	740.6	74.19	3710		90984	132006	145206
480	772.8	77.42	3871		112329	166216	182837
500	805.0	80.65	4032		138640	209246	230171

Table 19

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY FOR DAILY TRAVEL OF 17.14 MILES AND MAXIMUM LOAD OF 50 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Operation	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	1.17	47	47	47	47	52
20	32.2	2.33	93	101	97	97	107
30	48.3	3.50	140	162	150	151	166
40	64.4	4.67	187	232	206	208	229
50	80.5	5.83	233	315	266	269	296
60	96.6	7.00	280	413	329	335	368
70	112.7	8.17	327	531	397	405	445
80	128.8	9.33	373	675	469	480	528
90	144.9	10.50	420	856	545	560	616
100	161.0	11.67	467	1090	626	645	710
110	177.1	12.84	513	1404	712	737	811
120	193.2	14.00	560	1848	804	835	918
130	209.3	15.17	607	2523	901	939	1033
140	225.4	16.34	653	3571	1005	1051	1156
150	241.5	17.50	700	-	1115	1171	1288
160	257.6	18.67	747	14117	1232	1299	1428
170	273.7	19.84	793		1356	1435	1579
180	289.8	21.00	840		1488	1581	1739
190	305.9	22.17	887		1629	1738	1911
200	322.0	23.34	933		1778	1905	2095
220	354.2	25.67	1027		2105	2274	2501
240	386.4	28.00	1120		2474	2696	2966
260	418.6	30.34	1214		2892	3179	3497
280	450.8	32.67	1307		3363	3731	4104
300	483.0	35.01	1400		3895	4362	4798
320	515.2	37.34	1494		4497	5083	5591
340	547.4	39.67	1587		5176	5907	6497
360	579.6	42.01	1680		5944	6849	7533
380	611.8	44.34	1774		6811	7925	8718
400	644.0	46.67	1867		7790	9156	10071
420	676.2	49.01	1960		8896	10563	11619
440	708.4	51.34	2054		10146	12170	13388
460	740.6	53.68	2147		11557	14008	15409
480	772.8	56.01	2240		13152	16109	17720
500	805.0	58.34	2334		14953	18511	20362

Table 20

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR DAILY TRAVEL OF 15.50 MILES AND MAXIMUM LOAD
OF 55 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	1.29	47	48	47	47	52
20	32.2	2.58	94	102	97	98	108
30	48.3	3.87	141	164	151	152	167
40	64.4	5.16	188	235	208	210	231
50	80.5	6.45	235	319	268	272	299
60	96.6	7.74	282	419	332	338	372
70	112.7	9.03	328	540	401	409	450
80	128.8	10.32	375	688	473	485	533
90	144.9	11.61	422	875	550	566	622
100	161.0	12.90	469	1117	633	652	718
110	177.1	14.19	516	1445	720	745	820
120	193.2	15.48	563	1914	813	844	929
130	209.3	16.77	610	2636	911	950	1045
140	225.4	18.06	657	3899	1016	1064	1170
150	241.5	19.35	704	6664	1128	1185	1304
160	257.6	20.65	751	17563	1247	1315	1447
170	273.7	21.94	798		1373	1454	1600
180	289.8	23.23	845		1507	1603	1763
190	305.9	24.52	891		1650	1762	1938
200	322.0	25.81	938		1801	1932	2125
220	354.2	28.39	1032		2134	2308	2539
240	386.4	30.97	1126		2510	2739	3013
260	418.6	33.55	1220		2936	3232	3555
280	450.8	36.13	1314		3417	3796	4176
300	483.0	38.71	1408		3961	4442	4886
320	515.2	41.29	1501		4576	5180	5698
340	547.4	43.87	1595		5271	6025	6628
360	579.6	46.45	1689		6057	6992	7691
380	611.8	49.03	1783		6946	8099	8908
400	644.0	51.61	1877		7950	9365	10301
420	676.2	54.19	1971		9086	10813	11895
440	708.4	56.77	2065		10371	12471	13718
460	740.6	59.35	2158		11823	14367	15804
480	772.8	61.94	2252		13465	16538	18192
500	805.0	64.52	2346		15322	19021	20923

Table 21

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY FOR DAILY TRAVEL OF 12.40 MILES AND MAXIMUM LOAD OF 55 POUNDS PER MAN

Supply Movement Distance			Case 1	Case 2	Case 3	Case 4	
			No Food Carried	Porters Carry Own Food	Staging Operation	Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	1.61	59	60	60	60	66
20	32.2	3.23	117	132	124	124	137
30	48.3	4.84	176	216	193	195	214
40	64.4	6.45	235	319	268	272	299
50	80.5	8.06	293	447	349	355	391
60	96.6	9.68	352	610	436	446	491
70	112.7	11.29	411	823	531	545	599
80	128.8	12.90	469	1117	633	652	718
90	144.9	14.52	528	1546	743	769	846
100	161.0	16.13	587	2232	861	896	986
110	177.1	17.74	645	3502	989	1035	1138
120	193.2	19.35	704	5664	1128	1185	1304
130	209.3	20.97	762	28212	1277	1349	1484
140	225.4	22.58	821		1439	1527	1680
150	241.5	24.19	880		1613	1721	1893
160	257.6	25.81	938		1801	1932	2125
170	273.7	27.42	997		2004	2161	2377
180	289.8	29.03	1056		2224	2411	2652
190	305.9	30.65	1114		2461	2682	2950
200	322.0	32.26	1173		2717	2977	3275
220	354.2	35.48	1290		3291	3648	4013
240	386.4	38.71	1408		3961	4442	4886
260	418.6	41.94	1525		4741	5381	5919
280	450.8	45.16	1642		5652	6492	7142
300	483.0	48.39	1760		6713	7808	8589
320	515.2	51.61	1877		7350	9365	10301
340	547.4	54.84	1994		9393	11207	12328
360	579.6	58.06	2111		11075	13387	14726
380	611.8	61.29	2229		13036	15967	17564
400	644.0	64.52	2346		15322	19021	20923
420	676.2	67.74	2463		17987	22635	24898
440	708.4	70.97	2581		21095	26911	29603
460	740.6	74.19	2698		24718	31973	35170
480	772.8	77.42	2815		28941	37962	41759
500	805.0	80.65	2933		33866	45051	49556

Table 22

MANPOWER REQUIREMENTS PER TON OF THROUGHPUT PER DAY
FOR DAILY TRAVEL OF 9.00 MILES AND MAXIMUM LOAD
OF 60 POUNDS PER MAN

Supply Movement Distance			Case 1 No Food Carried	Case 2 Porters Carry Own Food	Case 3 Staging Opera-tion	Case 4 Staging Operation With Supervision, 10 percent added	
Miles	Km	Stages	Porters	Porters	Porters	Porters	Total
10	16.1	2.22	74	78	76	76	84
20	32.2	4.44	148	175	160	161	177
30	48.3	6.67	222	298	252	256	281
40	64.4	8.89	296	458	354	361	397
50	80.5	11.11	370	675	466	478	525
60	96.6	13.33	444	990	590	608	668
70	112.7	15.56	519	1492	726	752	827
80	128.8	17.78	593	2365	877	913	1004
90	144.9	20.00	667	4405	1042	1092	1201
100	161.0	22.22	741	14225	1224	1291	1420
110	177.1	24.44	815		1425	1513	1664
120	193.2	26.67	889		1647	1759	1935
130	209.3	28.89	963		1891	2034	2237
140	225.4	31.11	1037		2160	2339	2572
150	241.5	33.33	1111		2456	2678	2946
160	257.6	35.56	1185		2783	3055	3361
170	273.7	37.78	1259		3143	3475	3823
180	289.8	40.00	1333		3539	3943	4337
190	305.9	42.22	1407		3976	4462	4908
200	322.0	44.44	1481		4458	5040	5544
220	354.2	48.89	1630		5573	6399	7039
240	386.4	53.33	1778		6928	8081	8889
260	418.6	57.78	1926		8573	10162	11178
280	450.8	62.22	2074		10571	12738	14012
300	483.0	66.67	2222		12997	15926	17518
320	515.2	71.11	2370		15942	19871	21858
340	547.4	75.56	2519		19520	24753	27229
360	579.6	80.00	2667		23864	30796	33876
380	611.8	84.44	2815		29139	38274	42102
400	644.0	88.89	2963		35545	47530	52283
420	676.2	93.33	3111		43325	58984	64882
440	708.4	97.78	3259		52771	73160	80476
460	740.6	102.22	3407		64243	90704	99774
480	772.8	106.67	3556		78174	112416	123658
500	805.0	111.11	3704		95091	139288	153216

VII. PORTER DENSITY AND TRAIL CAPACITY

Tables in the preceding four sections can be used to provide data on the number of porters assigned to individual stages and the number of porters per mile of route. On large-scale porterage operations, this procedure can be used to determine whether trails are adequate to handle the number of porters involved, and to compute the number of porters who would be within radius of weapons dropped along the trail. On smaller-scale porterage operations, the number of porters in motion per mile at any given time is a necessary factor in computing the probability that an observer will detect that the trail is in use (for example, with an airborne night-vision device). The number of porters passing a given point on the trail per hour or per day may be useful for estimating the chance that observers will notice something unusual when the operation is on a very small scale and is being conducted with maximum secrecy.

The number of porters per stage can be obtained from whichever table in Sec. V (Tables 2 through 14) corresponds to the porter payload capacity; number of porters per mile can be obtained from the same table by converting from stages to miles, or directly from one of the Sec. VI tables (Tables 15 through 22) if the combination of payload and daily travel distance matches one of the tables in this section. In case 2 (each porter carries own food) the porters are distributed equally among stages in the journey. In cases 3 and 4 there are more porters in the earlier stages, and the distribution of porters among stages or among 10-mile and 20-mile sections of the trail can be determined from the table for the appropriate porter workload. This is illustrated in a following example.

Two additional inputs are needed to determine porter density on the trail from porters assigned per mile or per stage. One is the number of hours per day the trail is in use; the other is the number of hours per round trip that each porter is in motion along the trail, which can, of course, be determined from stage length and walking speed. If there are alternate trails, it becomes possible to divide the porter traffic among them and this will of course reduce density on any one trail.

If all porters make their daily round trip wholly in daylight (or, alternatively, wholly in darkness), then trails may be used for only a small part of each day by a group of porters carrying loads forward in the morning and returning to their operating base in the afternoon. In this case there will be some activity along the trail all day but only in a particular section at any one time. At the other extreme, porters may be able to start their journey at any time during the day or night and the trail may be in constant use. If there is only one trail, it may be more efficient to move porters in groups timed to pass at specific places, and avoid having two-way trail traffic at the same time on particularly difficult sections of trail. A high-volume portera;e operation may require full-time use of trails in order to keep porters an acceptable distance apart, or to minimize the number of porters unloading, loading, or resting at the destination at any one time.

Walking speed on the trail has been estimated as 1.5 mph (for six hours) in the Himalayas and as an average 1 mile per hour

under combat conditions in Korea, including allowance for any rest stops made along the trail. The daily travel of Ref. 3, 15 miles per day loaded or 20 miles per day without load, might be interpreted as somewhere in the range of 1.5 mph to 2.5 mph loaded (for a 10-hour day and a 6-hour day, respectively) and 2 mph to 3.3 mph without a load. If each hour is divided into 50 minutes movement and 10 minutes rest, actual walking speeds are somewhat higher, and would be within the range of 1.8 mph to 3 mph loaded and 2.4 mph to 4 mph light. Anything over 3 mph seems high for Southeast Asian practice, and it is probably sensible to use the 10-hour day with rest periods as the basis for computation when a stage length of 8.57 miles is used, so that a day's work for a porter would be approximately as follows: forward travel for 5-3/4 hours, divided into 4-3/4 at 1.8 mph and one hour of distributed rest periods, and 4-1/4 hours of return travel which includes 3-1/2 hours at 2.4 mph and 3/4 hour of en route rest. The unloading and resting time at the destination is in addition to this 10-hour day.

The resulting assumptions of a walking speed of 1.8 mph with a load and 2.4 mph without a load can be used with any of the assumed stage lengths and porter payloads.

Example. Porters are used to transport 20 tons per day along a 120-mile supply line. Porter payload is 50 pounds, and daily travel is 15 miles if loaded, 20 miles if empty, or 17.14 miles if carrying a load for 8.57 miles and returning the same day without a load.

Trails are open at all times and porters know the way well enough to carry loads and maintain these speeds at night. There is only one trail but it is wide enough for porters to pass without interference. How many porters might a reconnaissance aircraft expect to see in motion on a one-mile length of trail near the origin? How many on a one-mile length of trail just before the destination?

Table Used. This is handled most easily by using Table 6, "Manpower requirement per ton of throughput per day for porter load of 50 pounds," for a supply movement distance of (120)/(8.57) = 14 stages.

Case 1: Food Available. The 550 porters per ton, or 11,200 porters, are distributed uniformly over the 120 miles for a porter density of 93 porters per mile of trail. Each porter walks for about 8.3 hours per day; since trails are in use for 24 hours, the average number walking on any one-mile stretch at any given time is (8.3)/(24) or .346 of these 93, which is 32 porters.

Case 2: Porters Carry Own Food. This method requires 1847 porters per ton, or 36,940 porters; these are uniformly distributed over 120 miles at 308 porters per mile. At any one time, .346 of these, or 107, can be expected to be in motion.

Case 3: Staging. Porters per stage per ton of daily throughput vary from a total of 82 on the last two stages to a total of (804 - 650) = 154 on the first two stages. The number per mile therefore varies from (154)/(17.14) = 8.98 per ton, or 180 for 20 tons near the beginning of the journey, to 96 per mile on the final stages. The factor of .346 in motion at any one time is applicable to both of these, so that a reconnaissance aircraft might expect to find 62 porters in motion.

on a one-mile section of one of the first two stages and 33 per mile on a one-mile section of the last two stages.

Case 4: Staging with Supervision. The computational method is the same here as for case 3, starting with 82 porters per stage per ton of daily throughput in the destination stages and with (834 - 671) = 163 in the first stages. Porters in motion in a one-mile section at any given time will average 70 porters near the beginning of the supply line and 33 near the end. If the supervisors travel with the porters, the expected number of "moving targets" increases by 10 percent to 77 and 36 porters per mile.

Trail Capacity. The porter density for case 2 is the largest for these cases: 107 porters in motion on one mile of trail; this is two-way traffic, and with faster walking speeds on the return trip the average number on one mile of trail is 61 traveling with loads and 46 returning light. This is an average spacing of 87 feet for loaded porters and 115 feet for returning porters, which is not near saturation level.

VIII. THE IMPACT OF FOOD RATION WEIGHT

The tables of Secs. V and VI are based on a food consumption requirement of 2.68 pounds per man per day. Changes in food consumption do not affect porter requirements when food is available en route (Case 1 of these tables); but even a small increase in the daily ration can cause a significant increase in porter requirements for long multistage porterage (Cases 3 and 4), or shorten the maximum practical distance for porterage when each porter carries his own food and loads are not consolidated (Case 3).

An intermediate case from Sec. VI -- porter load 50 pounds, and daily travel distance 15 miles loaded or 20 miles light (averaging 17.14 miles per day) -- has been computed for several food ration weights for Cases 2 and 3. The 2.68-pound ration yields results identical with those of Table 19, repeated here for easy comparison with ration weights of 1.75, 3.0, and 4.0 pounds. The 1.75-pound ration represents a situation in which rice and salt must be carried, but supplementary foods (vegetables, meat, sauces) are available from local sources along the route; the 3-pound and 4-pound cases are alternative levels of the total ration. Case 2 results are shown in Table 23, and Case 3 results in Table 24. The equations used are those of Sec. IV, with d = 17.14 miles and p = 50 pounds (0.025 ton).

Table 23

COMPARATIVE PORTER REQUIREMENTS FOR VARIOUS FOOD RATION WEIGHTS; PORTERS CARRY OWN FOOD; NO STAGING OR LOAD CONSOLIDATION

Supply Movement Distance			Porters Required When Daily Ration Is:			
Mi	Km	Stages	1.75 lb	2.68 lb	3 lb	4 lb
10	16.1	1.17	47	47	47	47
20	32.2	2.33	98	101	101	104
30	48.3	3.50	153	162	165	175
40	64.4	4.67	214	232	239	264
50	80.5	5.83	281	315	329	381
60	96.6	7.00	355	413	438	539
70	112.7	8.17	436	531	573	766
80	128.8	9.33	527	675	747	1,121
90	144.9	10.50	629	856	977	1,751
100	161.0	11.67	745	1,090	1,297	3,186
110	177.1	12.84	877	1,404	1,771	9,658
120	193.2	14.00	1,028	1,848	2,548	(a)
130	209.3	15.17	1,204	2,523	4,049	(a)
140	225.4	16.34	1,411	3,671	8,185	(a)
150	241.5	17.50	1,657	6,065	71,259	(a)
160	257.6	18.67	1,9[illegible]	14,117	(a)	(a)

NOTE: Porter load 50 pounds; daily travel 17.14 miles. Porter requirements are per ton of throughput per day.

[a]Porterage over this distance is not possible without staging unless food is available en route.

Table 24

COMPARATIVE PORTER REQUIREMENTS FOR VARIOUS FOOD RATION WEIGHTS; STAGING OPERATION

Supply Movement Distance			Porters Required When Daily Ration Is:			
Mi	Km	Stages	1.75 lb	2.68 lb	3 lb	4 lb
10	16.1	1.17	47	47	47	47
20	32.2	2.33	96	97	97	98
30	48.3	3.50	146	150	151	155
40	64.4	4.67	199	206	208	216
50	80.5	5.83	254	266	270	283
60	96.6	7.00	311	329	336	357
70	112.7	8.17	371	397	406	438
80	128.8	9.33	433	469	482	526
90	144.9	10.50	497	545	563	622
100	161.0	11.67	565	626	649	727
110	177.1	12.84	634	712	742	843
120	193.2	14.00	707	804	841	969
130	209.3	15.17	783	901	947	1,107
140	225.4	16.34	862	1,005	1,060	1,258
150	241.5	17.50	944	1,115	1,182	1,423
160	257.6	18.67	1,029	1,232	1,312	1,604
170	273.7	19.84	1,118	1,356	1,451	1,801
180	289.8	21.00	1,211	1,488	1,600	2,018
190	305.9	22.17	1,307	1,629	1,760	2,254
200	322.0	23.34	1,408	1,778	1,930	2,513
220	354.2	25.67	1,621	2,105	2,309	3,106
240	386.4	28.00	1,852	2,474	2,742	3,815
260	418.6	30.34	2,102	2,892	3,239	4,664
280	450.8	32.67	2,374	3,363	3,807	5,680
300	483.0	35.01	2,668	3,895	4,459	6,896
320	515.2	37.34	2,986	4,497	5,206	8,351
340	547.4	39.67	3,331	5,176	6,061	10,033
360	579.6	42.01	3,705	5,944	7,041	12,177
380	611.8	44.34	4,111	6,811	8,164	14,671
400	644.0	46.67	4,550	7,790	9,450	17,655
420	676.2	49.01	5,026	8,896	10,924	21,227
440	708.4	51.34	5,541	10,146	12,612	25,502
460	740.6	53.68	6,100	11,557	14,546	30,618
480	772.8	56.01	6,706	13,152	16,762	36,740
500	805.0	58.34	7,362	14,953	19,301	44,067

NOTE: Porter load 50 pounds; daily travel 17.14 miles. Porter requirements are per ton of throughput per day.

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10. ABSTRACT

Tables and computation methods for evaluating the load that can be carried by porters under various conditions. The logistic importance of porterage has been a disputed issue in American military planning. This study shows quantitatively its value in such areas as Thailand and Vietnam, and its costliness and inefficiency in areas of jungle and mountain. Data were drawn from specific historical accounts, much of it unclassified data from classified RAND publications. The most detailed information is from UN and North Korean experience in the Korean conflict, the Viet Minh planning factors in Indochina, and the 1963 American expedition up Mt. Everest. Weight carried and daily travel distance were related to the geographic, military, and physical conditions. Average ton-miles per man/day range from .04 to .21 and speed varies from 1.8 to 3 mph, depending on terrain, illumination, etc. Methods of estimating trail capacity and the probability of observation are given, and different staging policies are evaluated.

11. KEY WORDS

Logistics
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